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The Context of Archipelago Traditional Cake to Explore Students' Understanding in Integers Division Class VII

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Abstract

This study aims to explore the students' mathematical understanding in integers division operation through the context of archipelago traditional cakes in class VII. This research is related to the Indonesian Realistic Mathematics Approach (PMRI) as a learning approach used. The methodology used in this study is Design Research consisting of three stages: preliminary design, experimental design, and retrospective analysis. The study was conducted for VII grade students of SMPN 1 Palembang. The learning path (Hypothetical Learning Trajectory) in design research plays an important role as a research design and instrument. The Hypothetical Learning Trajectory (HLT) was developed together with a series of activities using the context of archipelago traditional cakes such as: omelette roll, bakpia, milk pie, etc. Media used in this study was the Students' Worksheet. The results of this study indicate that exploration using the context of traditional archipelago cakes can help students understanding in multiplication and division of integers. The conclusion of this study is the use of archipelago traditional cakes as starting point in mathematics learning in integer division operation material helps the students to explore their understanding in solving mathematics problems.

Keywords: Division Integer, PMRI, Traditional Archipelago Cakes, Student Activity Sheet

Abstrak

Penelitian ini bertujuan mengeksplorasi pemahaman matematika siswa dalam pembelajaran matematika operasi pembagian bilangan bulat dengan konteks kue tradisional nusantara di kelas VII. Penelitian ini terkait dengan Pendekatan Matematika Realistik Indonesia (PMRI) sebagai pendekatan dalam pembelajaran yang digunakan. Metodologi yang digunakan dalam penelitian ini adalah dengan Design Research terdiri dari tiga tahap: preliminary design, design experiment, dan retrospective analysis. Penelitian dilakukan pada siswa kelas VII SMPN 1 Palembang. Lintasan belajar (Hypothetical Learning Trajectory) dalam design research memegang peranan penting sebagai desain dan instrumen penelitian. Hypothetical Learning Trajectory (HLT) dikembangkan dan serangkaian kegiatan menggunakan konteks kue tradisional nusantara seperti: dadar gulung, bakpia, pie susu, dll. Media yang digunakan pada penelitian ini adalah Lembar Aktivitas siswa. Hasil penelitian ini menunjukkan bahwa dengan menggunakan konteks kue tradisional nusantara dapat membantu mengeksplorasi pemahaman siswa pada operasi perkalian dan pembagian bulat.

Kata kunci: Pembagian Bilangan Bulat, PMRI, Kue Tradisional Nusantara, Lembar Aktivitas Siswa.

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INTRODUCTION

Indonesian Government clearly states that education should be relevant with the needs of life. In addition, it should offer chances to students to implement their knowledge in society (Kemendikbud, 2013). Math learning should be packed and planned attractively in order to make the students comfortable and motivated, to change their perception about math and to relieve anxiety so that they become addicted to learn math (Kemendikbud, 2016). In school, math is less attractive, most of the students are not happy when it comes to learn math. Moreover, math, according to their

perception, is hard to be learnt (Siregar, 2017; Widjayanti, Masfingatin, & Setyansah, 2019). It was resulted on the students' learning achievement which becomes low. Thus, in learning activity, teacher should take role as mediator and facilitator who should help students' difficulties so that learning process can occur very well (Ugi, Djadir, & Darwis, 2016).

Undoubtedly, students' negative impressions toward math will influence their motivation in the process of learning (Widjayanti, Masfingatin, & Setyansah, 2019). Integer is one of important material which should have been taught to the students since elementary school because it is a math material which is linked to each other. In integer, there are four kinds of calculation operation which are considered, one of them is division operation (Sulistiawati, 2014).

According to Musser, Bugger, & Peterson (2005), division of integers is inversion operation of integer multiplication. One of the efforts to improve understanding of integers division in school is to teach math which is started through realistic concept or realistic problem activity which refers to PMRI Education. PMRI is adaptation of Realistic Mathematic Education whereas math learning is seen as human activity which has to be related to students' daily life context (Zulkardi, 2002; Putri, Dolk, & Zulkardi, 2015). The context used can be daily life problems (Van den Heuvel-Panhuizen, 2003; Utari, Putri, & Hartono, 2015).

The use of context in math learning enables the concept of math itself to be meaningful. This is because the context can bring abstract math concept into representative one which is easy to be understood (Nasution, Putri, & Zulkardi, 2018). Besides, the use of context in math learning can also benefit the students in developing explicit relation between contexts and math ideas which are useful for their development of math thinking (Widjaja, 2013; Utari, Putri, & Hartono, 2015). Kusumah and Sugiman (2010) state that in realistic math education, real problems are put in the start of the learning which will be then used by the students to conduct mathematical process and development model of math so that math is seen as human activity.

In line with the study in this article, some studies have shown that by exploring food and culture context (either national or local), it helps the students to understand math and its relationship to daily life, to understand the concepts of important math materials, and to make them become motivated in learning (Lestariningsih, Putri, & Darmawijoyo, 2012; Nurmalia, Hartono, & Putri, 2013; Zainab, Zulkardi, & Hartono, 2013; Putri, Dolk, & Zulkardi, 2015; Disnawati, Hartono, Putri, 2012). Based on the background which has been presented above, this study aims at exploring students' understanding in math learning of integers division operation by using archipelago traditional cake context in class VII.

METHODS

This study used *design research* method which is one of qualitative approaches (Plomp & Nieveen, 2010). Design Research aims to developing *local instruction theory* (Gravemeijer & Van

Eerde, 2009). This study involved 29 students of class VII in SMP Negeri 1 Palembang and a teacher in that class as a model. This research was conducted in odd semester in 2017/2018 academic year. The data have been collected by using video recorder, observation, students' works and interview. The whole data were analyzed through descriptive qualitative approach. Design Research has three stages: preparing for experiment, designing the experiment, and retrospective analysis (Gravemeijer & Cobb, 2006; Bakker, 2004).

In the preparing for the experiment stage, the researcher conducted literature study about integer division operation material and using PMRI as teaching approach. The researcher also explored initial ability of the students by interviewing some of them. The result of interviews could be used as a base to see how far the students understand the material of prerequisite learning. The result was also used to design series of learning activities which contain Hypothetical Learning Trajectory (HLT). The designed HLT is dynamic so that it will create cyclic process which can be changed and developed during teaching process experiment (Putri, Dolk, & Zulkardi, 2015).

The second stage, design experiment, contains two cycles, they are cycle 1 (pilot experiment) and cycle 2 (teaching experiment). In cycle 1, the researcher took role as teacher and involved two learning groups with high, mediocre, and low heterogenic ability. The result of cycle 1 was used to revise the first version of HLT for one class which took participation in cycle 2. In cycle 2, the students were taught by their school teacher as model teacher, and the researcher took role as observer toward learning activity. The third stage is *retrospective analysis*. The data collected from the teaching experiment stage, were analyzed to develop the design in the upcoming learning activity (Putri, Dolk, & Zulkardi, 2015).

RESULTS AND DISCUSSION

This learning was designed to produce learning trajectory in integer division operation learning material and to solve problems by using archipelago traditional cake context through PMRI approach which promotes junior high school students' understanding in math. Before learning was started, in order to know students' initial ability, the researcher conducted interviews to the students who were the subject of this study. Moreover, the researcher also conducted pre-test about integer division operation. The result of pre-test showed that the students are capable in integer division operation by doing inversion operation of multiplication.

After finding out students' initial ability through post-test, then, cycle 1, pilot experiment, was conducted. At this stage, it involved eight (8) students who were divided into 2 heterogenic groups and the researcher herself as a model teacher. The result of this pilot experiment showed that the students, together in the groups, were capable to conduct integer division operation based on a given problem. Then, retrospective analysis of cycle 1 was conducted. The result of this stage was used for the purpose of improvement (if necessary) before coming to teaching experiment stage. After

conducting retrospective analysis of cycle 1, it was found that the actual learning trajectory, the process during teaching and learning, was in line with HLT which has been designed.

Furthermore, teaching experiment stage or cycle 2 was conducted. There were two problems which were given to the students about integer division operation. The problems I can be seen in the Figure 1.

In Mrs Melani's house, she wants to order Indonesian traditional cakes for social gathering. the member's of the social gathering are 35 person. the tradional cakes will be order are putu ayu, dadar gulung, onde-onde and lemper. everyone gets a plate of cakes. if each plate will contain 4 different cake, how many amount of each kind of cake should be order by Mrs Melani?

Figure 1. Problem I for students

Problem I in Figure 1 aims at enabling students to apply their knowledge toward concept of division operation. The first step was the students were asked to understand the problem first, and read comprehensively. The context of archipelago traditional food became starting point in this problem. The final result of the given problem in figure 1 asked the students to count how many the number of each cake is instead of the total number of the cake. The students' answer can be seen in the Figure 2.

$4 \times 35 = 140 \text{ kue}$

$140 : 4 = 35$

Jadi, 1 macam kue harus dibeli 35 buah

$35 \times 4 = 140$

Jadi, Ibu Melani harus memesan kue sebanyak $140 : 4$

kue putu	= 35
Dadar gulung	= 35
lemper	= 35
onde - onde	= 35
+	
<u>140</u>	

(a) The answer of student A

(b) The answer of student B

Figure 2. Students' answer of problem I

It can be seen from Figure 2 (a) and (b), both of the students answered the same problem with different strategy. Students A directly multiplied four kinds of cake which was ordered with the number of gathering participants. After finding the result, student A divided those number with the total of the cake in each plate so that one kind of cake should be ordered 35 pieces. It is consistent with the concept of division operation proposed by Musser, Bugger, & Peterson (2005). They state that division is the result of multiplication inversion operation of integers. On the contrary, student B used different strategy by multiplying four kinds of the cake with the total number of gathering participants. After finding the result, then, student B concluded that the cake which should be ordered

was 140 pieces, then, wrote each number of the cake and totalized it back to become 140 pieces of cake. This strategy is not consistent with the concept of division.

From the answer of both students, it can be seen that the process of problem solving was different. Student B has made a mistake; student B totalized back the number of the amount of each cake which made it inappropriate with the right concept. Meanwhile, student A was capable to understand the problem well even though the given information was incomplete. Even so, student A has used the concept of integers division which is multiplication inversion operation of integers.

Thus, the purpose of PMRI Education is appropriate with those proposed by Yansen, Putri, Zulkardi & Fatimah (2019) learning is started by presenting realistic or contextual problems to make learning process easy. This will enable the students to relate events which have been experienced with the concept of math that they learn. At this stage, teacher role is pivotal. Teacher has to observe, to remind back, or to guide his/her students' works until those students realize and fix their mistakes. By doing this, it is hoped that for the next problems, the students will not make any conceptual mistakes and procedures, and they will be more careful in reading and solving the problems. From 29 students, below are the students' best answer and the wrong answer for the problem 1.

Diketahui : anggota acara arisan komplek : 35
 Jenis kue = 4 kue (masing-masing orang satu piring kue berisi 4 jenis kue)
 $= 35 \times 4 = 140 \text{ kue}$
 $140 : 4 = 35$
 Jadi masing-masing kue diberi 35 buah

Figure 3. Student's right answer (perfect)

1 piring kue = 4 orang anggota 35 orang
 jadi, itu harus memesek 120 kue lagi

Figure 4. Student's wrong answer

The use of archipelago traditional cake to explore students' math understanding in integers division operation material in problem 1 can be said useful since it helps students to understand math in daily life. Moreover, it helps the students to reasoning in solving the given problems. The process of reasoning occurs when the students apply the concept of multiplication and division of integers in order to seek the number of cake which was ordered in gathering event.

Based on the problem 1, it indicates that the students have already learnt in accordance with HLT which was designed. Even though there was mistake in the answer of student B, this student was basically capable in understanding the problem and in writing what in his mind was by using his own knowledge and words clearly. The student needs more guidance only in solving the problem.

Furthermore the problem II can be seen in Figure 5.

Jenis-Jenis Makanan	
- Aceh	- Pulut
- Medan	- Bika Ambon
- Palembang	- Pempek
- Jakarta	- Kerak Telor
- Bandung	- Serabi
- Yogyakarta	- Bakpia
- Semarang	- Lumpia
- Bali	- Pie Susu

6 members of Dito's family is visiting the Indonesian traditional snacks festival in the Malay village. After getting around the festival, the first child prefers bakpia from Yogyakarta, the third child prefers pancake from Bandung, and then the second and youngest children prefer milk pie from Bali and empek-empek from Palembang. If the first child pays Rp. 30,000.00 for 2 boxes of bakpia, and the third child pays Rp. 24,000.00 for 3 boxes of pancake, and then the second and youngest pay Rp. 20,000.00 for 4 boxes of milk pie and Rp. 20,000.00 for 5 boxes of empek-empek, how much is the price for each item of Mr. Dito's children's snacks?

Figure 6. Problem given to the students

The problem 2 in figure 6 aims at enabling the students to use division concept. In addition, the students are also asked to be able to analyze problem first, read and understand it comprehensively. The context of archipelago traditional cake becomes starting point in this problem. The final result which was given in figure 6 asked the students to count how much the price of each cake bought by Mr. Dito's sons was instead of the total number of the cake. The following were the answer of the students.

2 kotak bakpia : 30.000
 \rightarrow : 1 kotak = 15.000
 3 buah Serabi : 24.000
 \rightarrow : 1 Serabi = 8.000
 10 buah empek-empek : 20.000
 \rightarrow : 1 pempek = 2.000
 4 buah pie susu : 20.000
 \rightarrow : 1 buah pie = 5.000

Figure 7. The answer of student A

2 kotak : 30.000 = 15
 24.000 : 3 buah = 8
 20.000 : 4 buah = 5
 20.000 : 10 buah = 2

Figure 8. The answer of student B

From Figure 7 and Figure 8, the both of the students answered the problems by using different strategy. Student A, at first, wrote the number of the cake bought by each of Mr. Dito's sons and then wrote every price of the cake. Afterward, he divided the price with the number of cakes which have been bought so that the final result can be obtained. However, student A didn't write evidence whether the cake belongs to the first, second, third or fourth son. Even so, student A has been able to

use the concept of division. It is consistent with the concept of division operation proposed by Musser, Bugger, & Peterson, 2005. They state that division is the result of multiplication inversion operation of integers.

Meanwhile, student B used different strategy by dividing the price with the number of the cakes which have been bought. However, there was incomplete answer in this strategy. This is consistent with what was demanded by the problem. After dividing the number of the cakes with the price which were paid, student B only wrote the numeral 15, 8, 5, and 2 without evidences. This is not consistent with the concept of integers division. Based on problem 1 and 2, and by analyzing the answer of the students, it can be concluded that both of the students have different answer model influenced by the strategy and their own mindset.

Like in problem 1, the students in problem 2 have learnt consistently with HLT which has been designed. Even though the answer of student B is not good enough, since he doesn't give evidence completely in his answer, teacher has to take a role and give more attention in guiding this student. Teacher has to help this student to revise the mistake in order to understand the correct concept, procedure, and result. Among 29 students who solved the problem, below is the figure of the best answer which is consistent with the concept and procedure for problem 2.

Anak pertama	= Rp 30.000	= $30.000 : 2$	= Rp. 15.000
Anak ketiga	= Rp 24.000	= $24.000 : 3$	= Rp. 8.000
Anak kedua	= Rp 20.000	= $20.000 : 4$	= Rp 5.000
Anak bungsu	= Rp 20.000	= $20.000 : 10$	= Rp. 2.000
Jadi, 1 kotak bakpia	= Rp. 15.000		
1 buah getabi	= Rp 8.000		
1 buah pie	= Rp 5.000		
1 buah pempek	= Rp. 2.000		

Figure 9. Student's correct answer in problem 2

In problem 2, there was no significant mistake or blank on students' answer. All of the students answer the problem even though there were some of them whose answer was just like student B which didn't contain complete evidences. The use of archipelago traditional cake to explore students' math understanding in integer division operation material in problem 2 can be said useful since it helps students to understand math in daily life. Moreover, it helps the students to reasoning in solving the given problems. The process of reasoning occurs when the students apply the concept of multiplication and division of integer in order to seek the number and the price of each cake.

Series of activities which have been conducted through PMRI approach have showed PMRI characteristics argued by Putri & Zulkardi (2018): PMRI characteristics become fundamental foundation in learning process in each problem. (a) *The use of contexts for phenomenologist exploration* is the first characteristic whereas learning activity is started by introducing contextual problem faced by the students in daily life as experienced-based activity; (b) *The use of models for*

mathematical concept construction. Geometry and social problem which can be imagined by the students are situational level. The use of archipelago traditional cake context is an off model of integer division operation which is referential level.

Furthermore, the third of PMRI characteristic namely (c) *The use of students' creations and contribution*. This characteristic can be seen in the learning process of integer multiplication operation of the given problems. Teacher gives appreciation to the students' contribution in learning process, either in groups or individually. Learning becomes more meaningful due to students' variation of answers and strategies in solving the problem; (d) *Students activity and interactivity on the learning process*. Interactivity between students and teacher occurs in every learning activity. Students in this teaching experiment are very cooperative so that learning process run well. e) *Intertwining mathematics concepts, aspects, and units (connectivity)*. Designing integer division operation learning cannot be conducted unless it is connected with other materials such as the concept of integer addition, subtraction, and multiplication operation which become prerequisite of this learning.

Retrospective Analysis

In the first and second problem, it has been shown that the students have learnt consistently with the designed HLT. It can be seen from the fact that the students were able to find some strategies to solve the problem 1 and 2. It indicates that the students have understood correctly the concept of how to divide integers in the context of archipelago traditional cakes. The result of teaching experiment showed that actual learning trajectory, the process during learning, was consistent with the designed HLT.

CONCLUSION

The use of archipelago traditional cake in solving the problem of integers division using PMRI approach is useful to help students' math understanding. Through the designed activities, students achieved understanding using their informal intuition to solve the problem formally in more mathematical way. It is due to the teacher who started the lesson by introducing the context at first, which was taken from students' daily life and the use of the context in learning so that the principles of realistic math are fulfilled. Thus, it can be concluded that the use of archipelago traditional cakes as starting point in math learning in integer division operation material helps the students to explore their math understanding in solving math problems.

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